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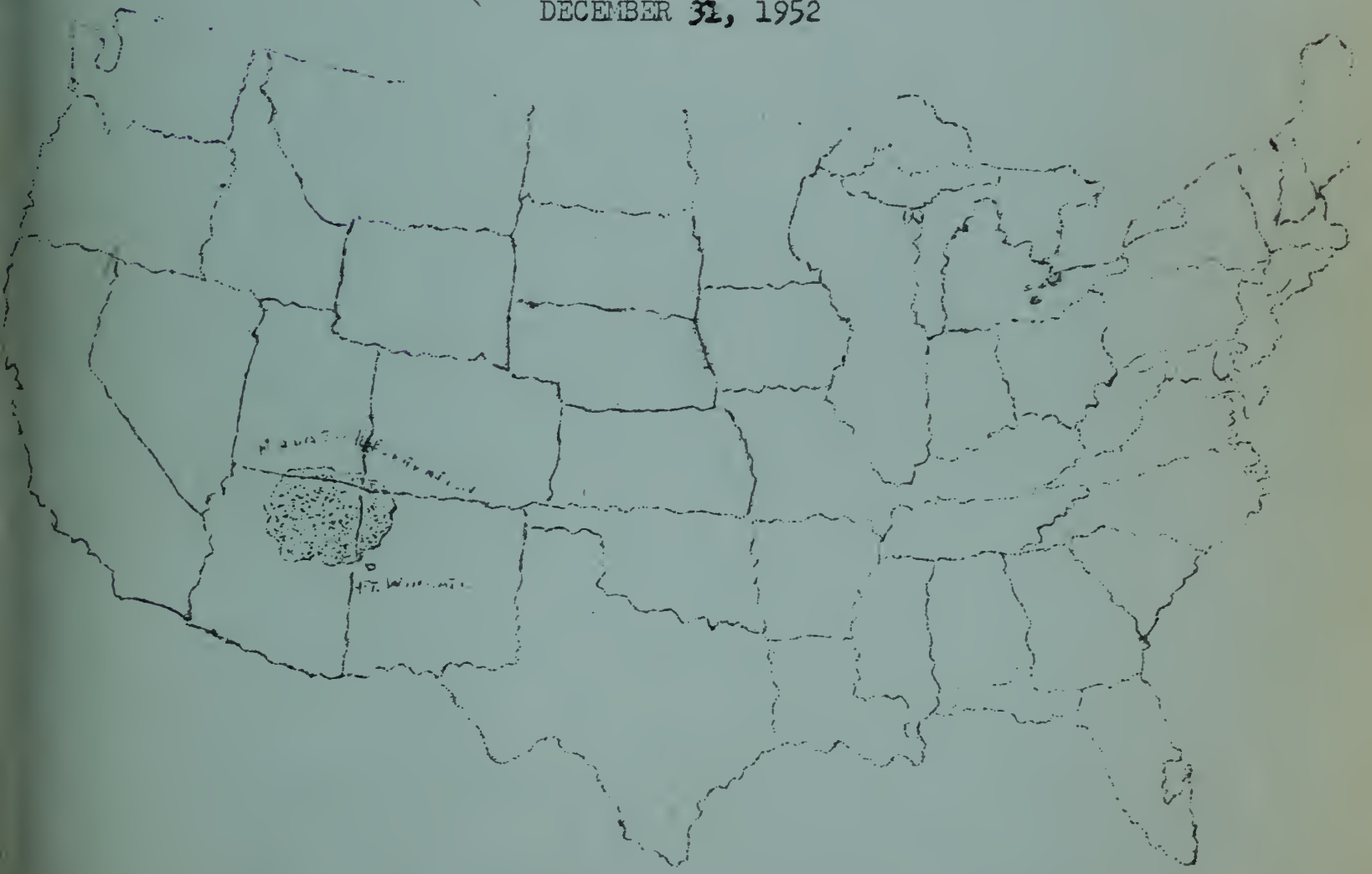
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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
AND THE
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

SIXTEENTH ANNUAL REPORT
OF THE
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

DECEMBER 31, 1952



THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE
USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF
RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

Roster of Personnel

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
James O. Grandstaff ¹	Animal Husbandman	Jan. 13, 1944	Director
Stanley L. Smith	Animal Husbandman	Jul. 23, 1952	Director
George M. Sidwell	Animal Husbandman	Dec. 1, 1946	Genetics
Donald A. Price ²	Animal Husbandman	Mar. 21, 1949	Sheep Invest- igations
Gordon L. Jessup, Jr.	Animal Husbandman	Mar. 17, 1952	Sheep Invest- igations
Vern B. Swanson	Animal Husbandman	Apr. 10, 1951	Sheep Manage- ment
Alison S. Dodge	Clerk-Stenographer	June 3, 1951	Clerical
Jimmie Gleason	Janitor	Apr. 1, 1942	Janitor and Miscellaneous
Marion Chadacloi	Laboratory Aid	Jan. 12, 1944	Miscellaneous
Alfred Dempsey	Agricultural Aid	Dec. 23, 1947	Miscellaneous
Fred Deschene	Agricultural Aid	Oct. 2, 1947	Miscellaneous

1 Resigned March 16, 1952

2 Resigned December 7, 1951

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the semi-arid range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

OUTLINE OF RESEARCH PROGRAM

In order to achieve the above objective, in the development of breeds and strains of sheep suitable to the southwestern ranges and to the economic requirements of the sheepmen, there are four active research projects under way. These projects are listed as follows:

1. Improvement of Navajo sheep by linebreeding and selection in the Navajo strain.
2. Improvement of Navajo sheep by crossbreeding and selection for the production of wool suitable for both hand and commercial methods of manufacture.
3. Improvement of Navajo sheep by crossbreeding and selection for range production of wool and lambs.
4. Development of an efficient method of selecting animals used in the program of the Southwestern Range and Sheep Breeding Laboratory.

(NOTE: When reference is made to the above projects in the following sections of this report, only the number preceding the project title will be used.)

Research and Marketing Act Project:

RM-a-427-4 I Subtitle (BAI) Evaluation of wool from sheep, goats and rabbits with respect to fabrication, felting and insulation values. Line project title: Properties of blanket and rug wools of known genetic origin and history in relation to their use in fabrication, felting and insulating values.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement:
J. M. Cooper, the Sheep Breeder, May 1939.
2. The Sheep Industry of Indians in the Southwest:
J. M. Cooper and Dewey Dismuke, Indians at Work, August 1939.
3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation:
J. M. Cooper, American Society of Animal Production, 1939.
4. Improvement of the Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, March 1940.
5. Breeding for Quality Wool:
James O. Grandstaff, The National Wool Grower, July 1940.
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers:
James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.
7. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint:
James O. Grandstaff, Rayon Textile Monthly, October-November 1941.
8. Wool Characteristics in Relation to Navajo Weaving:
James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.
9. Characteristics and Production of Old-Type Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, May 1943.
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs:
Cecil T. Blunn, Journal of Animal Science, February 1944.
11. A Preliminary Report on the Post-Natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep:
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.
12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep:
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944.
13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs:
Cecil T. Blunn, Journal of Animal Science, August 1945.

13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs:
Cecil T. Blunn, Journal of Animal Science, August 1945.
14. Evaluating Fleece Quality of Navajo Sheep from Small Samples:
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.
15. Improvement of Wool for Navajo Hand Weaving:
James O. Grandstaff and Cecil T. Blunn, Indians at Work, March 1945.
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs:
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947.
17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses:
James O. Grandstaff, Journal of Animal Science, November 1948.
18. Size of Lambs at Weaning as a Permanent Characteristic of Navajo Ewes:
George M. Sidwell and James O. Grandstaff, Journal of Animal Science, August 1949.
19. Adaptation of Livestock to New Environments: James O. Grandstaff, for publication in Proc. United Nations Scientific Conference on Conservation and Utilization of Resources, Lake Success, New York, 1949.
20. Fertility and Reproduction in Sheep in Relation to Breeding and Environment:
James O. Grandstaff, presented at International Symposium on High Altitude Biology held at Lima, Peru, South America, November 23-30, 1949.
21. Genetic and Environmental Factors affecting Staple Length in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, James O. Grandstaff and Donald A. Price, Journal of Animal Science, February 1951.
22. Lamb Production of Navajo Ewes Bred to Columbia and Romney Rams, and Navajo Crossbred Ewes Bred to Lincoln and Cotswold Rams:
Donald A. Price, James O. Grandstaff and George M. Sidwell, Journal of Animal Science, February 1951.
23. Genetic and Environmental Factors Affecting Type and Condition in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, Donald A. Price and James O. Grandstaff, Journal of Animal Science, May 1951.

SUMMARY OF PRECIPITATION

	Average 1864-1911	Average 1938-47	1948	1949	1950	1951	1952	Average 1948-52
January	.96	.83	.24	1.33	.63	1.26	2.95	1.28
February	1.42	.55	1.19	.50	1.01	.56	.48	.75
March	1.02	.97	1.15	.53	.17	.20	1.31	.67
April	.98	.68	.13	.23	.00	.84	1.94	.63
May	.58	.69	.58	.39	.02	.53	.22	.35
June	.69	.47	1.09	.80	.25	.02	1.32	.70
July	2.34	1.31	2.38	2.13	1.52	1.58	3.49	2.22
August	2.31	2.53	2.23	1.53	.56	1.84	1.69	1.57
September	1.37	1.37	1.14	1.53	1.24	.71	.78	1.08
October	1.05	1.34	.69	.82	.00	.86	.00	.47
November	.76	.62	.17	.00	.52	.69	3.19	.91
December	.97	1.03	1.64	.95	.14	1.17	.58	.90
TOTAL	14.45	12.44	12.63	10.74	6.06	10.26	17.95	11.53

The above table summarizes the precipitation at Fort Wingate, New Mexico for the 47-year period, 1864-1911 and for the 15-year period, 1938-1952. The total precipitation of 17.95 inches for 1952 was the second highest since 1938, being exceeded only by 1941 when 18.47 inches were recorded. It was 24.2 percent above the 47 year average, 44.3 percent above the 10 year average of 1938-1947, and 55.7 percent above the 1948-1952 average.

SUMMARY OF YEAR'S OPERATIONS

As reported in the Fifteenth Annual Report, precipitation during the fall months of 1951 was considerably below normal. Range forage plants consequently failed to make sufficient growth to produce the quantity of feed needed to carry the flock through the winter months. Upon completion of the breeding season, therefore, the ewe and lamb flocks were shipped on January 10, 1952 to Topock, Arizona where desert forage was plentiful.

Feed on the desert was more than abundant and the sheep returned to Fort Wingate on April 15 in excellent condition. This fact helps explain the coarser fleeces and increased body weights for 1952. Scoring, sampling and shearing were completed the last two weeks of April and lambing began the first of May.

After lambing, the flock was moved by truck to the El Morro range where they remained until fall. Precipitation was above average in June, July and August and feed was excellent as evidenced by the second highest weaning weights on record for the Laboratory, being exceeded only by those in 1947. The lambs were weaned on September 2nd, and the ewe and lamb flocks were culled the week of October 13-16, 1952.

Semen testing of the breeding rams was conducted from November 12 to November 28, 1952 and the ewes were returned to Fort Wingate for pen mating on December 1. The ewes were weighed and turned into the breeding pens on December 4, 1952 where they remained until January 13, 1953.

A conference was held at Fort Wingate on September 16 - 17, 1952 to determine future plans for the Laboratory. (See page 7). In accordance with the plan to secure 400 average ewes from the Navajo Reservation to establish an up-grading and sheep improvement project, the fall and winter months of 1952-1953 were spent in securing these ewes.

REPORT ON WOOL CONFERENCE

A meeting of the representatives of the cooperating agencies was held at the Southwestern Range and Sheep Breeding Laboratory, Fort Wingate, New Mexico on September 16 - 17, 1952. Purpose of the meeting was to discuss the objectives of the Laboratory, and to redirect these objectives toward new goals, if necessary.

After a review of the history and accomplishments of the Laboratory since its inception in 1935, considerable time was given to discussing the needs of the Navajos in regards to sheep and wool. To further these needs of the Navajos and to redirect the program of the Laboratory toward new goals, the committee unanimously agreed to the following plan of work:

- (1) Maintain the nucleus of the Navajo line with a minimum of 100 breeding ewes and continue improvement of the sheep in this line through selection. Sire and progeny testing will be continued.
- (2) Select the best 300 breeding ewes in the coarsewool groups (quarter-blood weaving wool) for a composite group and continue purification of the line and improvement of their productive potential. Sire and progeny testing will be continued.
- (3) Continue the Targhee line with approximately 100 breeding ewes, this line having shown considerable promise. Sire and progeny testing to be continued as before.
- (4) Four hundred ewes will be secured from reservation sources to establish an up-breeding, sheep improvement experiment. Selection of the ewes will be based on present and past visual observations by Extension and Laboratory personnel, so that the ewes will, as nearly as possible, represent the average of present-day reservation sheep. It is intended that management practices for this group of sheep will be consistent with practices applicable and available to Navajo flockmasters. These ewes to be divided into four groups and bred as follows:
 - (a) One hundred ewes to be range bred to ten fine wool rams from the Tribal ram herd. These rams are to be the same type and quality as available to Navajo sheep producers. Rams that will be used from the Tribal flock are grade Rambouillet rams that have met the New Mexico Experiment Station requirements for type, uniformity, fineness of fiber and staple length.

- (b) One hundred ewes to be range bred to ten crossbred rams developed at the Laboratory having quarter blood (weaving wool) fleeces.
 - (c) One hundred ewes to be range bred to ten Targhee rams which will be secured from outside sources. Targhee rams produced at the Western Sheep Breeding Laboratory, Dubois, Idaho will be preferred.
 - (d) One hundred ewes to be used as a control group and range bred to ten rams of the same quality as the ewes. Rams used in this control group will be selected from reservation sources and will be below the average of the Tribal ram herd enterprise. They will, however, be comparable to rams used by Navajo flockmasters who, generally speaking, have produced their own rams with little consideration being given to productive ability. If possible, management of the control group will be such that no genetic gain or loss will occur.
- (5) To maintain a local source of weaving wool for Navajo craftsmen, the Extension personnel for the Bureau of Indian Affairs proposes to select Navajo cooperators whose primary interest is the production of weaving wool, and to provide them, on a loan basis, crossbred rams from the Laboratory. In exchange for the use of the rams, the cooperators will agree to keep such records of performance on the rams as will be mutually agreed upon by Laboratory and Extension personnel.

Present at the conference were the following officials of the cooperating agencies:

T. C. Byerly
A. C. Cooley
P. E. Neale
J. O. Grandstaff
R. G. Fister
Howard F. Johnson
John Christenson
Brice H. Sewell
Stanley L. Smith
Vern B. Swanson
G. L. Jessup, Jr.

OUTLINE OF BREEDING PROGRAM
FOR 1951-52 BREEDING SEASON

<u>Number of Breeding Group</u>	<u>Breeding of Rams</u>		<u>Breeding of Ewes</u>	<u>No. of Ewes</u>
1	N	x	N	175
8	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	x	K x N	11
9	K x N	x	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	90
10	R x N	x	$L \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	135
11	$L \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	x	R x N	60
12	T	x	$\begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	117
13	$T \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	x	$T \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	40
T 14	T	x	K x N	40
T 15	T	x	R x N	40
16	$K \times N \times C_2 \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	x	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix} \times K \times N$	100
17	$R \times N \times L \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix}$	x	$L \times \begin{pmatrix} C_1 & \times & N \\ R & \times & N \end{pmatrix} \times \begin{pmatrix} R & \times & N \\ C_1 & \times & N \end{pmatrix} \times R \times N$	38
TOTAL				973

Code of Symbols for Breeds

C_1 - Corriedale
 C_2 - Cotswold

K - Columbia
L - Lincoln
N - Navajo

K - Romney
T - Targhee

SUMMARY OF BREEDING PROGRAM

The breeding flock for the 1951-1952 season consisted of 973 ewes. This number is 83 percent of the number of ewes bred in the 1950-1951 season. The reduction in number is due to the large number (235) of ewes killed in the flood and hail storm on May 29, 1951 at Towner, Colorado. Due to drought conditions and lack of available range feed the ewes previously used in test pen matings were also eliminated from the breeding flock.

The various breeding groups were associated with the research line projects as follows:

<u>Breeding Group</u>	<u>No. of Matings</u>	<u>Research Project No.</u>
1	173	1
8, 9, 10, 11, 16, 17	554	2
T12, T13, T14, T15	246	3

Only 173 full-blood Navajo ewes were available for breeding in the 1951-1952 season. The reduction in number is due to large death losses in the hail storm and flood of May, 1951 and rather severe culling of aged ewes thought necessary due to drought conditions. All Navajo ewes were bred to Navajo rams, (Group No. 1).

Groups 6 and 7 were discontinued in 1950. These groups involved the matings of Lincoln and Cotswold rams to ewes having an inheritance of $1/2$ Navajo, $1/4$ Romney and $1/4$ Corriedale. The ewes from these groups have been mated to Targhee rams in group 12.

In group 8, 117 F_1 Columbia x Navajo ewes were mated to Cotswold cross rams originating from group 7. The 96 matings in group 9 are the reciprocal of those in group 8.

In group 10, 134 Lincoln cross ewes were mated to F_1 Romney x Navajo rams. The ewes in this group are the offspring from group 6 matings. The 69 ewes in group 11 are the reciprocal of those in group 10.

The ewes and rams in group 16 and 17 are the progeny of mating in groups 8 and 9, and 10 and 11 respectively. These breeding groups are the final crosses in one phase of research project 2.

Group 12, one of the three groups associated with project 3, was made up of 117 crossbred ewes carrying an inheritance of $1/2$ Navajo, $1/4$ Romney and $1/4$ Corriedale and mated to Targhee rams.

Group 13 includes the progeny from group 12, while groups 14 and 15 are made up of ewes $1/2$ Columbia and $1/2$ Navajo and ewes $1/2$ Romney and $1/2$ Navajo, respectively, mated to Targhee rams.

MEASUREMENT OF BODY WEIGHTS, SCORES, FLEECE CHARACTERISTICS AND SELECTION PROCEDURE

In 1952, the lambs were born during the month of May at the Laboratory headquarters. In June, the ewes and lambs were moved to the summer range near El Morro, New Mexico. The lambs were weaned on September 2, at approximately 120 days of age. At weaning time each lamb was weighed individually and the weight recorded to the nearest pound. Face covering, type, condition and outercoat scores were taken by a committee of two men working independently. Also color score, degree of horn development and any abnormality of the jaw were recorded. Small fleece samples were collected from the middle of the left side and thigh of each lamb at weaning time. From these samples, staple length was measured to the nearest .1 cm. and the percentage of kemp and other medullated fibers and average fiber diameter were recorded. The staple length measurement represented a constant age of 84 days since a small area was clipped close to the skin when the average age of the lamb was one month and the sample was taken from this area at weaning time.

Culling of the weanling lambs was done in October. The lambs were sorted by sex into their respective breeding pens to facilitate the work of selection. The lambs in each pen were considered individually for all traits evaluated at weaning time. The degree of selection practiced on each pen of lambs depended upon the individual merit of the lambs and the quality and uniformity of the pen of lambs as a group.

The fleeces of yearling ewes and rams and mature breeding rams were sampled a few days previous to shearing for the evaluation of staple length, grade, percentages of kemp and other medullated fibers and clean yield. Staple length was measured to the nearest .1 cm. at the side, while average fiber diameter and frequency of kemp and other medullated fibers were measured and recorded for both side and thigh positions. The clean yield was determined from a large sample of wool taken at the side and placed in an air tight can until it was scoured at a later date.

At shearing time, the weight of each fleece was recorded to the nearest .05 pound. The grease and clean fleece weights were adjusted to a constant age of 365 days.

RESEARCH PROJECT 1

IMPROVEMENT OF NAVAJO SHEEP BY LINEBREEDING AND SELECTION IN THE NAVAJO STRAIN

The objective of this project is the improvement of the Navajo strain of sheep in wool production and mutton conformation. This strain of sheep have greatest value as a source of inheritance for hardiness and adaptability to semi-arid areas, high fertility and mothering ability. Improvement in the quality and quantity of the fleece as well as improvement in mutton conformation will increase their usefulness for crossbreeding with improved breeds.

Data on the characteristics and production of the Navajo ewes and rams, and the traits of their weanling and yearling progeny are summarized in this section.

The data on weanling lambs has been adjusted to a constant age and for differences due to type of birth and rearing and for age of dam.

CHARACTERISTICS OF NAVAJO BREEDING RAMS

Number of rams used, age of the rams at lambing and fleece characteristics of the Navajo rams mated to Navajo ewes in the years 1947 through 1952 are summarized in the following table. The data were taken on all rams at yearling age. The rams used have been selected primarily for quality and quantity of wool with some emphasis on body weight, type, condition and color of face and legs. Since it is not known how severely inbreeding might affect the Navajo sheep, five rams rather than a fewer number are now being used. Until the Navajo strain possesses more of the desirable characteristics both in fleece and body conformation, inbreeding will be held to a minimum as far as it is practical to do so.

Year	No. of rams	Age of rams at lambing (years)	Fleece weights as yearlings		Yearling Fiber Traits at Side Grade	Fiber Traits at Side	
			Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Medullated fibers (percent)
1947	3	3.0	6.98	4.93	50s	17.2	1.1
1948	4	3.0	7.56	5.02	48s	18.4	.0
1949	4	4.0	7.15	4.86	48s	17.8	.0
1950	4	2.8	6.93	4.39	48s	13.9	1.8
1951	5	2.8	7.01	4.11	50s	13.1	.0
1952	5	3.4	6.04	3.50	50s	11.9	.5
Total & Averages	25	2.3	6.91	4.39	50s	15.1	.5

CHARACTERISTICS OF NAVAJO BREEDING EWES

The following table summarizes the characteristics of the Navajo ewes bred to Navajo rams in the years 1947 through 1952. All traits except the 18 month body weight were measured at yearling age. As fewer Navajo ewes are now needed in the crossbreeding program, more stringent culling can be exercised, and more progress from selection can be made. Since most of the traits in the table are greatly affected by many environmental factors, especially that due to years, no very good comparison between years can be made. There is some evidence that the incidence of kemp fibers is being reduced, and also the trend is toward younger ewes in the breeding flock.

Year	No. of Ewes	Age of ewes at lambling (yrs.)	Body wt. at 18 months (lbs.)	Fleece weights as yearlings		Grade	Staple length (cms.)	Kemp (per- cent)	Other med. fibers (percent)
				Grease (lbs.)	Clean (lbs.)				
1947	116	5.7	96.7	4.60	3.18	58s	9.5	0.9	1.7
1948	120	7.4	99.4	5.34	3.68	58s	9.0	0.6	0.6
1949	133	5.0	101.1	5.51	3.64	58s	10.0	0.3	0.8
1950	140	5.1	102.8	5.68	3.69	58s	10.2	0.2	1.2
1951	156	4.9	98.2	5.15	3.08	56s	11.1	0.0	1.5
1952	173	4.8	97.7	5.22	2.91	58s	10.9	0.1	1.6
Total & Averages	835	5.4	99.3	5.26	3.34	58s	10.2	0.3	1.3

LAMB PRODUCTION OF NAVAJO MATINGS

The 1951 lamb production of Navajo ewes mated to Navajo rams is summarized in the following table. The average weaning weight for the first two 5-year periods constitutes weights unadjusted for any of the measurable environmental effects, and represents a growth of about 140 days. The individual years from 1947 through 1952 represent weights adjusted to a constant age of 120 days and corrected for type of birth and rearing of the lamb and age of the dam.

Although the lamb production of the Navajo ewes in 1952 does not equal, in some respects, the lamb production in 1947 and 1948, it is far better than the drought years of 1950 and 1951.

LAMB PRODUCTION OF NAVAJO MATINGS

Year	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning wt. in pounds	Pounds of lamb per ewe bred
1947-48	1745	88.3	105.1	97.3	92.5	57.0	55.4
1948-49	852	88.6	130.0	109.7	84.4	58.1	63.8
1949-50	670	79.6	107.4	79.8	72.7	48.8	43.3
1947	116	83.9	125.4	117.8	92.0	60.5	71.9
1948	120	78.9	128.5	103.3	80.4	57.3	64.4
1949	133	85.0	116.5	93.2	80.0	56.4	52.6
1950	140	61.4	78.3	68.1	87.0	42.4	28.9
1951	156	88.5	95.5	31.4	32.9	32.6	10.2
1952	173	82.1	104.0	99.4	95.5	59.5	59.1

FACE AND BODY SCORES OF NAVAJO WEANLING LAMBS

The face and body scores of the Navajo weanling lambs from 1947 to 1952 are summarized in the following table. These scores were not taken prior to 1947.

The Navajo weanling lambs are characterized by open faces, clean legs, poor body type with a tendency to fatten rather slowly, especially with regard to external fat. The ewe lambs have been consistently better, with regard to type and condition scores, than the ram lambs.

It is doubtful that any trend can be shown in these data in this table since the committees doing the scoring have not been the same from year to year and scoring standards change with different committees. Yearly environmental differences can also influence the type and condition scores as shown by the relatively poor scores taken in 1950 and 1951. This is especially noticeable in the ewe lamb scores.

FACE AND BODY SCORES OF NAVAJO WEANLING LAMBS

RAM LAMBS

EWE LAMBS

Year	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
1947	56	2.71	3.50	3.61	80	2.72	3.19	3.15
1948	73	2.83	3.10	2.88	59	2.76	3.04	2.73
1949	66	2.64	3.09	3.00	58	2.65	3.22	2.92
1950	54	2.44	3.36	4.38	40	2.33	3.23	4.02
1951	21	2.43	3.49	3.53	28	2.52	3.49	3.34
1952	90	2.10	3.68	3.74	82	2.03	3.12	3.09
Total & Averages	360	2.51	3.36	3.50	347	2.49	3.18	3.14

FLEECE CHARACTERISTICS OF NAVAJO WEANLING LAMBS

Data on fleece characteristics of the Navajo weanling lambs for the years 1947 through 1951 are summarized in the next table. In 1947, staple length was measured at a constant age of 111 days; in each of the years 1948, 1949, 1950 and 1952 it was measured at 84 days of growth, and in 1951 it was adjusted to a constant age of 120 days. These differences should be considered in comparing the means of the years given in this table.

Although rigid selection has been practiced against kemp and other medullated fibers, a small number of lambs are encountered each year with an appreciable number of these objectionable fibers.

Very little change is noted in outercoat score or staple length, while fiber diameter appears to be greatly affected by yearly environmental differences. More work needs to be done to determine the causes of these yearly fluctuations in fiber diameter.

FLEECE CHARACTERISTICS OF NAVAJO WEANLING LAMBS

Year	No. of lambs	Grade	Staple length (cms)	Kemp (percent)	Other med. fibers (percent)	Outercoat a/ (score)
1947	137	56s	4.7	0.0	0.4	-
1948	125	56s	3.4	.3	3.2	3.78
1949	124	50s	4.1	.2	2.1	3.18
1950	94	56s	3.3	.3	4.3	3.36
1951	49	60s	4.2	.0	3.5	3.27
1952	172	50s	3.6	.7	6.1	3.51
Total & Averages	701	56s	3.9	.3	3.3	3.45

a/ Scores for outer-coat not taken prior to 1948.

SELECTION PRACTICED ON NAVAJO LAMBS

The percentages of Navajo lambs saved, by sex, the selection differentials, for most of the economically important traits considered at weaning age, the relative emphasis placed on each trait at culling time, and the expected genetic gains are given in the following table.

From a total of 90 ram lambs only 8 were saved, and from a total of 82 ewe lambs, 41 were saved. Due to the reduced number of Navajo ewes needed for crossbreeding, a greater number of ewe lambs could be culled this year than in previous years.

The greatest emphasis at culling time, for the ram lambs, was placed on weaning weight, body type and outercoat score; condition was the only trait receiving negative emphasis. For the ewe lambs, the greatest emphasis was placed on weaning weight, staple length and condition score. Although not shown in the table, selection against color on the face and legs and kemp and other medullated fibers influenced the culling procedure to a marked degree. No very great expected genetic gains are evident in any trait except weaning weight.

Since an heritability estimate for face covering score has not been computed at this Station, the value obtained for range Targhee and Columbia lambs at Dubois, Idaho has been used to compute the expected genetic gain. Thus the estimate of expected genetic gain for face covering score is accurate only to the extent that the Dubois heritability estimate is representative of the lambs at this Station.

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR NAVAJO WEANLING LAMBS

Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
Heritability estimates	21%	6%	30%	40% *	4%	11%			
Rams									
Advantage of selected lambs	7.67	.08	.81	.10	.23	.02	.05	.54	9.76
Relative emphasis	1.04	.12	.34	.21	.44	.03	.05	.42	
Expected genetic gain	1.61	.00	.24	.05	.01	.00	-	-	
Ewes									
Advantage of selected lambs	2.31	.00	.00	.10	.14	.20	.18	.15	50.00
Relative emphasis	.38	.49	.00	.24	.25	.32	.17	.11	
Expected genetic gain	.48	.00	.00	.05	.00	.02	-	-	

* Heritability estimate for face covering score as obtained for range Tarheee and Columbia lambs at Dubois, Idaho.

BODY WEIGHTS AND SCORES OF NAVAJO YEARLING RAMS

Year	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer- coat (score)	a/
1947	2	115.0	2.25	3.17	3.09	1.50	-	
1948	6	115.2	2.23	3.20	2.96	1.17	-	
1949	14	112.3	2.33	2.89	2.64	1.36	2.24	
1950	10	103.5	2.60	3.00	2.97	1.50	2.07	
1951	9	90.9	2.58	2.67	3.13	1.00	3.60	
1952	2	101.0	1.94	3.06	3.44	1.00	2.00	
Total & Averages	43	105.8	2.40	2.93	2.92	1.28	2.52	

a/ Scores for outercoat not taken prior to 1949.

Only two Navajo yearling rams were saved from the 1951 lamb crop, these two rams being survivors of the drought and hail storm of 1951. Although heavier than other yearling rams in 1951, they were lighter in weight than in any of the preceding years. Type scores were not as good as in previous years, with the exception of 1947 and 1948, although in no year were condition scores better. Face covering and outercoat scores also appear to be better than in preceding years.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING RAMS

The fleece characteristics of all Navajo yearling rams from 1947 through 1952 are summarized in the following table. The fleeces of all rams have been free of kemp fibers as far as this can be determined from laboratory tests. Selection against kemp, other medullated fibers and coarse outer-coat fibers has improved the quality of the fleeces, but at the same time it has reduced the effectiveness of selection for fleece weight and staple length.

Year	No. of rams	Fleece weights		Grade	Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Medullated fibers (percent)
1947	2	7.18	4.70	46s	14.8	0.0
1948	6	6.65	3.88	48s	15.0	1.2
1949	14	6.43	4.30	56s	11.6	.1
1950	10	6.56	3.92	56s	12.6	.0
1951	9	5.82	3.32	50s	12.8	2.1
1952	2	5.39	3.07	50s	9.5	0.0
Totals & Averages	43	6.42	3.90	50s	12.6	0.6

BODY WEIGHTS AND SCORES OF NAVAJO YEARLING EWES

Only 11 yearling Navajo ewes were saved from the 1951 lamb crop. These ewes represent nearly all the surviving lambs of the 1951 drought and flood and may be considered as almost a random selection of the lambs born in 1951, as so few ewes were available very little selection could be practiced. Consequently, the weights and scores shown in the following table are below average in all traits except face covering.

Year	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)	a/
1947	39	84.6	2.07	3.29	3.13	2.46	-	
1948	75	86.8	2.58	2.97	2.68	1.32	-	
1949	55	77.9	2.31	2.74	2.49	1.72	3.08	
1950	46	75.7	2.43	2.84	2.91	1.30	3.05	
1951	26	46.6	2.51	3.35	3.20	1.88	3.38	
1952	11	75.4	1.92	3.06	3.22	2.39	3.91	
Total & Averages	252	77.9	2.38	2.99	2.82	1.68	3.19	

a/ Scores for outercoat not taken prior to 1949.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING EWES

The low fleece weights, both grease and clean, and the short staple length of the Navajo yearling ewes, no doubt reflect the severe environmental conditions to which they were subjected as lambs. The incidence of kemp and other medullated fibers, two traits less affected by environmental conditions, shows improvement over previous years. It is hoped that, with the elimination of these objectionable fibers, more emphasis can be placed on fleece weights.

Year	No. of ewes	Fleece weights		Grade	Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
1947	39	5.14	4.00	48s	11.4	0.1	3.0
1948	75	6.19	3.82	56s	12.5	.2	1.1
1949	55	5.73	3.69	58s	10.5	.5	3.0
1950	46	6.38	3.38	58s	11.4	.1	1.6
1951	26	3.27	1.75	64s	10.2	.1	0.9
1952	11	5.14	2.77	56s	9.1	.0	0.7
Total & Averages	252	5.61	3.48	56s	11.3	.2	1.6

RESEARCH PROJECT 2

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR THE PRODUCTION OF WOOL SUITABLE FOR BOTH HAND AND COMMERCIAL METHODS OF MANUFACTURE.

The objective of this research project is the development of coarse-wooled strains of sheep that combine adaptability to southwestern ranges with efficient production of good quality feeder lambs and wool of 46s, 48s and 50s grades. Selection emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

Information on the characteristics and production of the sheep used in project 2 are presented in this section.

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING RAMS

Various characteristics of the breeding rams used in research project 2 are presented in the following table. Since breeding groups 2, 3, 6 and 7 were eliminated in 1951, the 1950 totals shown at the bottom of the table include only those rams used in breeding groups 8, 9, 10, 11 and 16. The breeding of the rams in each group is given in the outline of breeding program at the beginning of this report. Breeding rams have been selected with major emphasis on fleece quality. Fleece characteristics considered are grade, staple length, uniformity, freedom from kemp and other medullated fibers, and yield of grease and clean wool.

The breeding rams in the 1952 season were below the average of the 1950 and 1951 rams in body weight, grease and clean fleece weight and staple length. Since most of these traits are affected by environmental circumstances, they no doubt reflect the effects of the drought and scanty feed conditions during the summer and fall months of 1951 and winter of 1952.

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING RAMS

Breeding Group No.	No. of rams	Age of ram at lambing time (years)	Body weight at breeding time (lbs.)	Fleece weights as Yearlings		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Med. fibers (percent)
8	3	4.0	194.3	10.20	5.63	48s	13.0	0.35
9	3	2.7	171.6	9.48	4.16	58s	11.5	0.43
10	4	2.5	150.7	8.64	5.00	50s	12.3	0.00
11	2	4.0	202.	11.48	6.79	48s	13.8	0.00
16	3	2.0	141.6	6.95	3.24	50s	10.5	0.00
17	1	2.0	125.0	5.35	3.23	48s	10.0	0.00
Total & Averages								
1952	16	2.9	165.9	8.92	4.73	50s	11.96	0.15
1951	18	2.5	181.4	10.31	5.79	50s	12.77	0.06
1950	15	2.4	178.9	10.48	6.97	48s	12.67	0.04

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING EWES

Average age of the ewes at lambing, body weight at 18 months, and yearling fleece characteristics of the breeding ewes in research project 2 are summarized by their respective breeding groups in the following table.

As was noted with the traits of the breeding rams, the characteristics of the ewes in 1952 were below the average of the traits of the ewes in 1951 and 1950 in all respects except percent of medullated fibers.

The extremely fine fiber diameter in groups 16 and 17 are no doubt due to the drought conditions when the fiber was developing. These grades at the side are based on the average fiber diameter at the base of the staple and are influenced by the health and plane of nutrition of the sheep during the late winter and early spring months. At this time of the year, range feed conditions are very poor. More work needs to be done to determine the extent environmental factors influence this characteristic. It is possible that the average of several cross-sections at different levels on the same staple would result in a more accurate measure of the true fiber diameter.

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING EWES

Breeding Group No.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 months (lbs.)	Fleece weights as Yearlings		Fiber Traits at Side			
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Per-cent Kemp	Per-cent other med. fibers
8	117	4.1	110.2	7.54	2.91	58s	10.4	0.01	1.15
9	96	4.0	104.5	7.29	3.79	56s	13.1	0.00	1.41
10	133	3.9	108.2	7.30	3.82	58s	11.6	0.00	1.13
11	69	3.8	101.2	6.87	3.36	58s	9.9	0.00	0.61
16	100	2.6	91.8	5.77	2.79	64s	10.7	0.01	0.75
17	38	2.0	77.8	4.29	2.12	70s	10.5	0.00	0.17

Total & Averages

1952	553	3.6	102.0	6.83	3.27	60s	11.2	0.005	0.98
1951	612	3.2	109.4	7.58	4.29	58s	11.3	0.01	1.27
1950 *	501	2.7	114.9	7.43	4.51	56s	11.1	0.00	1.74

* Since breeding groups 2, 3, 6 and 7 were discontinued in 1951, the totals for 1950 include only those ewes assigned to breeding groups 8, 9, 10, 11 and 16.

LAMB PRODUCTION OF COARSE WOOL, CROSSBRED MATINGS BY BREEDING GROUPS FOR 1952

Lamb production of the ewes in research project 2 is summarized by breeding groups in the following table. The lamb production summarized by 5-year periods, 1937-41, 1942-46 and 1947-51 is also shown.

The percent of ewes lambing is based on the number of ewes at breeding and still present at lambing time. This percentage is affected by the fertility of both the rams and the ewes. The percent of lambs weaned of live lambs born is a measure of lamb mortality.

The percent of ewes lambing, the average weaning weight and pounds of lamb weaned per ewe bred exceeded any of the 5-year averages. The low averages in group 17 can be attributed to the fact that all ewes in this group were 2-year old ewes, lambing for the first time. Since the ewes in the various groups are not all the same age, these figures are not directly comparable.

LAMB PRODUCTION OF COARSE WOOL, CROSSBRED MATINGS

Breeding Group No.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning wt. in pounds	Pounds of lamb per ewe bred
8	117	86.3	100.8	89.7	89.0	70.2	63.0
9	96	97.9	111.4	95.8	86.0	68.7	65.8
10	133	91.7	103.0	88.0	85.4	62.8	55.3
11	69	95.6	101.4	92.7	91.4	66.0	61.3
16	100	91.0	101.0	85.0	84.1	64.6	55.0
17	38	89.5	89.5	81.6	91.2	62.6	51.1
Total & Averages							
1952	553	90.6	102.5	89.3	87.1	66.2	59.1
By 5-Year Periods							
1937-41	1216	88.3	109.4	97.1	88.8	59.9	58.2
1942-46	1794	79.8	110.0	89.4	81.3	59.4	53.1
1947-51	3882	79.0	100.5	76.6	76.2	57.9	44.3

FACE AND BODY SCORES OF COARSE WOOL, CROSSBRED WEANLING LAMBS

In the following table, face and body scores of the weanling lambs are summarized by sex and groups for 1952 and by yearly averages by sex for 1949, 1950 and 1951.

Averages of the three scores indicate little difference between groups. The ewe lambs were consistently better in body type and condition than the ram lambs. Average condition scores for the ewe lambs were better than the preceding two years of 1950 and 1951, but inferior to the scores taken in 1949. Average type scores for the ewe lambs were superior to any of the preceding three years. Condition scores of the weanling ram lambs were better than those of 1950, but inferior to both 1949 and 1951. Type scores of the ram lambs for 1952 were superior to those taken in 1950 and 1951 but not as desirable as those of 1949. The lambs of both sexes are sufficiently open-faced as to eliminate any wool blindness.

FACE AND BODY SCORES OF COARSE WOOL, CROSSBRED WEANLING LAMBS

RAM LAMBS

EWES LAMBS

Breeding Group No.	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
8	48	2.49	2.76	3.31	57	2.42	2.39	2.51
9	53	2.18	2.85	3.42	38	2.17	2.31	2.41
10	60	2.37	2.88	3.46	57	2.05	2.45	2.72
11	30	2.29	2.63	3.42	34	2.19	2.16	2.49
16	40	2.42	2.95	3.36	45	2.47	2.64	2.65
17	18	2.26	2.59	3.42	13	1.90	2.51	2.87
Total & Averages								
1952	249	2.34	2.81	3.40	244	2.24	2.41	2.59
1951	133	2.70	3.14	3.26	117	2.63	3.18	3.25
1950	358	2.99	2.94	3.97	362	2.85	2.88	3.85
1949	311	3.04	2.45	2.51	318	2.98	2.57	2.49

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED WEANLING LAMBS

The following table summarizes the fiber characteristics of the weanling lambs in research project 2. Very little difference exists between years for any of the traits. However, some difference exists between groups in 1952. Lambs in group 8 had a larger percentage of medullated fibers and a poorer outer coat score than any other group of lambs. Group 10 lambs were next to the poorest in this respect. Lambs in group 17 were the only lambs entirely free of kemp fibers and also had the smallest percent of other medullated fibers. This same group of lambs was also more desirable with respect to fiber diameter.

Breeding Group No.	No. of lambs	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outer-coat (score)
8	105	56s	4.31	.10	4.01	3.29
9	91	56s	4.24	.19	2.88	2.68
10	117	56s	4.22	.10	3.70	2.99
11	64	56s	4.50	.10	1.93	2.69
16	85	56s	3.64	.06	1.72	2.63
17	31	50s	4.19	.00	1.36	2.58
Total & Averages						
1952	493	56s	4.18	.10	2.89	2.81
1951	250	60s	4.20	.08	2.19	2.97
1950	720	56s	3.90	.10	3.76	2.97
1949	628	56s	4.30	.20	3.29	2.96

SELECTION PRACTICED ON WEANLING LAMBS

The selection differentials, relative emphasis and expected genetic gain for the weanling lambs in research project 2 are given in the following table.

Weanling selection differentials are the average difference between the lambs saved and the total lambs weaned. It is important that these selection differentials be as large as possible since, for economic reasons, most of the culling must be done at weanling age. This is especially true of the ewe lambs.

The relative emphasis placed on each trait at culling is computed by dividing the selection differential by the standard deviation of that trait. The expected genetic gain was computed by multiplying the selection differential by the heritability. These figures, if divided by the generation interval (the average age of the sire and dam when the lambs were born) would give the expected genetic gain per year. The use of one half heritability times the selection differential for each sex and the sum of these products would give the expected genetic gain per generation from selection practiced at weaning age on both sexes. It should be pointed out that these gains from selection are only relative since all lambs saved at weaning will not produce offspring.

In general the most emphasis has been placed on weaning weight, and body type. Positive selection differentials for fiber diameter and selection against medullated fibers have resulted in slight selection pressure on staple length in some instances.

Since an heritability estimate for face covering score has not been computed at this station, the value obtained for range Targhee and Columbia lambs at Dubois, Idaho has been used. Thus the estimate of expected genetic gain is only accurate to the extent that the Dubois heritability is representative of the lambs at this station.

From a total of 249 ram lambs, 20 were saved and from a total of 244 ewe lambs, 136 were saved.

SELECTION PRACTICED ON COARSE WOOL, CROSSBRED WEANLING LAMBS

Group No.	Sex	Heritability	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Per-cent saved
8											
	Rams	Advantage of selected lambs	21% -.58	6% -.13	3% .85	46%* .02	4% .28	11% .16	-.31	-.15	10.4
		Relative emphasis	-.06	-.19	.34	.03	.49	.29	-.45	-.12	
		Expected genetic gain	-.12	-.00	.25	.01	.01	.02	-	-	
Ewes											
		Advantage of selected lambs	1.36	-.08	-.06	.08	.14	-.06	.08	.67	54.4
		Relative emphasis	.18	-.13	-.03	.14	.29	-.10	.08	.47	
		Expected genetic gain	.28	-.00	-.01	.04	.00	-.01	-	-	
9											
	Rams	Advantage of selected lambs	8.47	-.22	.97	.07	.84	-.08	.24	.99	5.7
		Relative emphasis	1.14	-.31	.57	.12	1.63	-.18	.27	.81	
		Expected genetic gain	1.78	-.01	.29	.03	.03	-.01	-	-	
Ewes											
		Advantage of selected lambs	2.84	-.01	.36	-.03	.18	.19	-.10	.67	57.9
		Relative emphasis	.39	-.02	.20	-.06	.37	.31	-.10	.50	
		Expected genetic gain	.60	-.00	.11	0.01	.00	.02	-	-	
10											
	Rams	Advantage of selected lambs	3.55	.25	.62	-.16	.34	-.15	.54	1.06	9.1
		Relative emphasis	.38	.35	.24	-.30	.41	-.27	.70	.80	
		Expected genetic gain	.75	.02	.19	-.07	.01	-.02	-	-	
Ewes											
		Advantage of selected lambs	1.47	.11	.14	.00	.07	.05	.04	.12	71.9
		Relative emphasis	.20	.17	.07	.00	.12	.08	.04	.09	
		Expected genetic gain	.31	.01	.04	.00	.00	.01	-	-	

* Heritability for face covering score as obtained for range Targhee and Columbia lambs at Dubois, Idaho.

SELECTION PRACTICED ON COARSE WOOL, CROSSBRED WEANLING LAMBS, CONT.

Group No.	Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Per-cent saved
11	Rams	Advantage of selected lambs	6.81	1.13	.29	.26	.18	-.39	.44	13.3
		Relative emphasis	.84	.58	.60	.43	.30	-.58	.47	
		Expected genetic gain	1.43	.34	.13	.01	.02	-	-	
	Ewes	Advantage of selected lambs	.88	.44	-.04	.18	.05	.20	.55	58.8
		Relative emphasis	.15	.20	-.07	.29	.08	.19	.43	
		Expected genetic gain	.18	.13	-.02	.01	.00	-	-	
16	Rams	Advantage of selected lambs	8.20	1.20	-.08	.26	.56	.16	-1.30	5.0
		Relative emphasis	.95	.54	-.13	.37	1.02	.16	-1.37	
		Expected genetic gain	1.72	.36	-.04	.01	.06	-	-	
	Ewes	Advantage of selected lambs	.02	.44	.10	.00	.00	.28	-.16	40.0
		Relative emphasis	.00	.19	.16	.00	.00	.24	-.11	
		Expected genetic gain	.00	.13	.05	.00	.00	-	-	
17	Rams	Advantage of selected lambs	6.98	1.71	0.07	.70	.23	-.48	-.05	5.0
		Relative emphasis	.74	.81	-.16	1.16	.49	-.62	-.06	
		Expected genetic gain	1.46	.51	-.03	.03	.02	-	-	
	Ewes	Advantage of selected lambs	5.84	.20	.15	.31	-.19	.15	1.08	30.6
		Relative emphasis	1.01	.11	.38	.59	-.43	.15	.80	
		Expected genetic gain	1.22	.06	.07	.01	-.02	-	-	

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING RAMS

The following table shows the body weights and scores of the yearling rams in research project 2. These rams are the survivors of the drought, hail storm and flood occurring in 1951. No rams were saved from groups 8 or 16, only one from group 11, two from group 9 and five from group 10, making a total of eight rams saved. The average body weight of all eight rams is above the average weight of the yearling rams in 1951, but below the average of 1950 and 1949. Average body type scores were below the average of all three previous years, but face covering and outercoat scores were improved.

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING RAMS

Breeding Group No.	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer- coat (score)
9	2	108.0	1.94	3.05	3.16	1.00	1.50
10	5	112.0	2.18	2.48	2.48	1.93	1.73
11	1	123.0	2.00	2.00	2.11	2.00	1.00
Totals & Averages							
1952	8	112.4	2.10	2.56	2.60	1.71	1.58
1951	66	109.7	2.96	2.32	2.70	1.36	2.81
1950	102	118.0	2.75	2.39	2.57	1.37	2.40
1949	98	126.0	2.63	2.21	2.20	1.38	2.56

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING RAMS

Little difference is evident between the fiber characteristics of the 1952 yearling rams and the preceding three years. None of the eight yearling rams in 1952 had any kemp or other medullated fibers in their fleeces as determined by laboratory analysis. They sheared slightly less grease wool than in any of the preceding years, but slightly more clean wool than in 1951.

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING RAMS

Breeding Group No.	No. of rams	Fleece weights		Grade	Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Other med. fibers (percent)
9	2	7.49	4.18	50s	10.7	0.00
10	5	8.41	4.58	50s	11.5	0.00
11	1	9.23	5.23	46s	12.6	0.00
Totals & Averages						
1952	8	8.28	4.56	50s	11.5	0.00
1951	66	8.67	3.93	50s	11.8	0.29
1950	102	9.28	5.61	50s	13.4	0.20
1949	101	9.40	6.46	50s	12.4	0.60

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING EWES

The body weights and scores of the yearling ewes in research project 2 are summarized in the following table. The 34 ewes saved to yearling age are the survivors of the 1951 drought year and the Kansas hail storm and flood. These ewes were heavier than in any of the preceding three years, had less face covering, very little difference in type score or condition score, slightly more color and were about the same with respect to outercoat score.

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING EWES

Breeding Group No.	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
8	8	93.1	2.12	2.24	2.20	2.91	3.49
9	7	80.6	1.93	2.71	2.45	2.76	2.74
10	9	83.9	1.85	2.39	2.33	2.44	2.53
11	8	84.4	2.00	2.53	2.63	2.54	3.13
16	2	96.5	2.00	2.27	2.22	3.00	2.06
Total & Averages							
1952	34	86.4	1.97	2.45	2.39	2.67	2.81
1951	189	53.5	2.90	2.70	2.94	1.40	2.89
1950	219	83.1	2.80	2.36	2.59	1.41	2.78
1949	260	85.4	2.34	2.22	2.27	1.38	2.74

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING EWES

No kemp fibers were found in any of the fleeces of the 1952 yearling ewes, and other medullated fibers were found in only one fleece. In all groups, the average grade was of the desired 50s. Although the grease and clean fleece weights were superior to those in 1951, they were slightly lighter than the fleeces of 1949 and 1950.

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING EWES

Breeding Group No.	No. of ewes	Fleece weights		Grade	Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Kemp (percent)	Other med fibers (percent)
8	8	7.26	3.68	50s	9.5	0.0	0.0
9	7	6.55	3.30	50s	8.8	0.0	0.3
10	9	6.39	2.99	50s	8.9	0.0	0.0
11	8	7.41	3.63	50s	8.6	0.0	0.0
16	2	6.38	2.98	50s	6.8	0.0	0.0
Totals & Averages							
1952	34	6.87	3.37	50s	8.9	0.0	0.1
1951	189	4.65	2.32	70s	11.2	0.0	0.3
1950	219	8.14	4.09	60s	12.0	0.0	0.4
1949	260	7.06	4.66	60s	10.8	0.1	0.9

RESEARCH PROJECT 3

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR RANGE PRODUCTION OF WOOL AND LAMBS SUITED TO MARKET REQUIREMENTS

The objective of this project is to develop a strain of sheep that will be well adapted to southwestern range conditions, with inheritance for efficient production of high quality feeder lambs and combing length wool between 60s and 62s grade. This project was initiated in 1948. The finest fleeced crossbred ewes with inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale were mated to rams of Targhee, New Zealand Merino and Debouillet breeds. A few Navajo ewes were mated to a Rambouillet ram to test the relative performance of these crosses under the same environmental conditions. Since these initial matings were made in 1948-49, only Targhee rams have been used with the ewes going into this research project.

The use of Targhee rams has been continued in group 12. The rams and ewes in group 13 are the progeny of previous Targhee matings. In addition to the Targhee F₁ ewes in this group, a few ewes sired by the Debouillet and Merino rams used in 1948-49 are included. Targhee rams are also used in groups T14 and T15, and mated to ewes sired by Columbia and Romney rams, respectively, and mothered by Navajo ewes.

CHARACTERISTICS OF FINE WOOL BREEDING RAMS

The number of rams used in each group, the age and body weight at lambing and the fleece characteristics at yearling age are given in the following table. Two of the Targhee rams used in group 12 and the one ram in group T14 were purchased from private breeders at about 18 months of age, and yearling fleece records were not available. For this reason, the data in the table are those records taken at two years of age. Other Targhee rams were obtained at the Western Sheep Breeding Laboratory, Dubois, Idaho and the data in the table are the records made at that Station.

Breeding Group No.	No. of rams	Age of ram at lambing (years)	Average body wt. at breeding time (lbs.)	Fleece weights as Yearlings		Fiber Traits at Side	
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12*	2	2.5	189.5	19.53*	7.19*	60s*	10.1*
12	2	4.5	204.5	11.60*	4.60*	64s*	9.3*
13	2	2.5	160.0	10.35	4.00	62s	9.8
T14*	1	3.0	185.0	18.60*	5.64*	60s*	8.7*
T15	1	6.0	196.0	11.00	5.60	70s	10.1
Totals & Averages							
1952*	3	2.7	188.0	19.22*	6.68*	60s*	9.6*
1952	5	4.0	185.0	10.98	4.68	64s	9.6
1951	12	3.0	194.9	10.83	5.10	64s	8.76
1950	5	4.0	189.8	12.69	6.92	64s	12.20
1949	4	3.2	-	13.02	6.84	64s	12.23

* Two of the 4 rams used in group 12 and the one ram in group T14 were purchased from private breeders. The data in the table are their 2-year-old record.

CHARACTERISTICS OF FINE WOOL, CROSSBRED BREEDING EWES

A total of 244 ewes were bred in research project 3. Grease fleece weights were heavier than in any previous year, and heavier clean weights were obtained than in 1950 and 1951, but not in 1949. In general the ewes were open faced and clean legged. The average grade of 58s in 1952 was coarser than the desired 60s - 62s. The fleeces of these ewes were relatively free from kemp and other medullated fibers.

Breeding Group No.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mos. (lbs.)	Fleece weights as yearlings		Grade	Staple length (cms.)	Kemp (per- cent)	Other Med. Fiber
				Grease (lbs.)	Clean (lbs.)				(per- cent)
12	117	5.9	107.2	6.92	3.31	56s	10.3	0.10	2.4
13	49	2.4	88.5	6.07	2.25	80s	8.4	0.00	0.0
T14	40	4.0	107.7	7.91	3.95	58s	10.6	0.00	1.3
T15	38	3.8	101.9	6.85	3.34	60s	9.8	0.00	0.8
Totals & Averages									
1952	244	4.5	102.7	6.90	3.21	58s	9.9	0.05	1.5
1951	390	4.9	101.9	6.29	2.94	56s	11.2	0.10	2.0
1950	156	5.8	107.5	5.48	3.07	60s	8.4	0.10	0.6
1949	127	5.2	108.8	5.76	3.22	60s	8.2	0.10	0.5

LAMB PRODUCTION OF FINE WOOL, CROSSBRED MATINGS

The lamb production of the ewes in research project 3 is summarized in the following table. The lamb production of the ewes in this project is better in every respect than in the two previous drought years.

As in the other research projects, the percent of ewes lambing is based on the number of ewes going into the breeding pens and still present at lambing. The percent of lambs born of ewes bred is based on the total lambs born, regardless of whether they were alive or dead, and the number of ewes bred still present at lambing. These two classifications are influenced by the fertility of the ram as well as the ewes in each pen. The percent of lambs weaned of live lambs born is a measure of lamb mortality. It should be remembered that the ewes in each group are not all the same age and the figures in this table are not directly comparable.

Breeding Group No.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
12	117	92.2	120.5	110.2	91.5	66.5	73.3
13	49	91.8	95.9	81.6	84.1	63.5	51.8
T14	40	97.4	110.3	97.4	87.4	66.5	64.8
T15	38	92.1	105.3	97.4	92.5	67.0	65.2
Total & Averages							
1952	244	93.4	111.5	100.4	90.0	66.1	66.3
1951	390	87.9	92.6	32.1	34.6	35.8	11.5
1950	156	60.3	85.8	63.9	74.4	45.3	29.0
1949	127	89.9	131.3	107.3	81.5	62.1	66.5

FACE AND BODY SCORES OF FINE WOOL, CROSSBRED WEANLING LAMBS

Face covering, body type and condition scores of the 1952 weanling lambs of research project 3 are summarized by sex and by breeding groups in the following table.

Averages for each trait show little difference between groups within sexes. The ewe lambs are consistently better than the ram lambs for all three characteristics. Average type scores of the ewe lambs for 1952 were better than any of the preceding three years. This was also true of face covering scores for both sexes. However all lambs are sufficiently open faced that wool blindness does not present a problem, and only rarely is a lamb culled because of too much wool on the face.

RAM LAMBS

EW E LAMBS

Breeding Group No.	No.of lambs	Face covering (score)	Type (score)	Condition (score)	No.of lambs	Face covering (score)	Type (score)	Condition (score)
12	67	2.65	2.88	3.12	62	2.29	2.45	2.52
13	19	2.47	2.74	3.22	21	2.17	2.30	2.55
T14	19	2.93	2.94	3.17	19	2.65	2.04	2.28
T15	19	2.47	2.79	3.22	18	2.39	2.13	2.42
Totals & Averages								
1952	124	2.64	2.85	3.16	120	2.34	2.31	2.47
1951	61	2.90	3.25	3.36	64	2.67	3.26	3.20
1950	47	3.07	3.70	2.94	52	2.91	2.91	3.58
1949	74	3.10	2.52	2.49	63	3.04	2.57	2.39

FIBER CHARACTERISTICS OF FINE WOOL, CROSSBRED WEANLING LAMBS

The following table summarizes by breeding groups the fiber characteristics of the weanling lambs in research project 3. Only small differences occur between any of the breeding groups with respect to most of the traits. Only in two groups were any kemp fibers found. Although the average of all groups in 1952 showed less outercoat fiber than in the preceding three years, the lambs are not as uniform with respect to fleece type as desired. Further selection against outercoat and medullated fibers will no doubt bring about finer fleeces which is also desirable.

Breeding Group No.	No. of lambs	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outercoat (score)
12	129	60s	3.17	.26	1.04	1.95
13	40	60s	3.33	.00	1.01	1.67
T14	38	58s	3.18	.03	.73	1.77
T15	37	58s	3.32	.00	.30	1.62
Totals & Averages						
1952	244	60s	3.22	.14	.88	1.78
1951	125	64s	3.50	.14	1.39	2.14
1950	99	62s	3.00	.10	.90	2.10
1949	137	60s	3.40	.10	.50	2.26

SELECTION PRACTICED ON FINE WOOL, CROSSBRED WEANLING LAMBS

The selection differentials, relative emphasis and the expected genetic gains for the weanling lambs in research project 3 are given in the following table. The computational procedures used are given in the preceding section (Page 25.). As pointed out in the previous sections, the heritability estimate for face covering score is that obtained at Dubois, Idaho for range Targhee and Columbia lambs because the heritability for that trait has not been computed for lambs at Fort Wingate. For that reason, the estimate of expected genetic gain is only accurate to the extent that the Dubois heritability pertains to the lambs at this station.

From a total of 124 ram lambs, 16 were saved, and from a total of 120 ewe lambs, 51 were saved.

In general, most emphasis was placed on weaning weight followed by staple length, body type and condition. In nearly every group and in both sexes, fiber diameter was given negative selection differentials, indicating selection was in the direction of coarse wool. In a few instances, selection favored the lambs with the poorest face scores and color scores.

SELECTION PRACTICED ON FINE WOOL, CROSSED WEANLING LAMBS

Group No.	Sex	Heritability	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
12											
Rams											
Advantage of selected lambs											
			5.32	.29	-.79	.21	.41	.32	-.09	.66	10.4
Relative emphasis											
			.71	.43	-.37	.33	.74	.50	-.13	.50	
Expected genetic gain											
			1.11	.02	-.24	.10	.02	.03	-	-	
Ewes											
Advantage of selected lambs											
			1.69	.14	-.19	.04	-.01	.20	.17	.29	45.2
Relative emphasis											
			.30	.28	-.09	.07	-.02	.32	.20	.24	
Expected genetic gain											
			.35	.01	-.06	.02	.00	.02	-	-	
13											
Rams											
Advantage of selected lambs											
			5.22	.32	-1.14	-.20	.19	.54	-1.19	.12	15.8
Relative emphasis											
			.69	.77	-.59	-.36	.32	.93	-1.35	.15	
Expected genetic gain											
			1.09	.02	-.34	-.09	.01	.06	-	-	
Ewes											
Advantage of selected lambs											
			4.11	.12	-.27	.12	.25	.17	.27	-.07	61.9
Relative emphasis											
			.52	.30	-.13	.31	.43	.31	.30	.10	
Expected genetic gain											
			.86	.01	-.08	.06	.01	.02	-	-	
T14											
Rams											
Advantage of selected lambs											
			8.70	.25	-.43	.15	.85	.26	.01	.65	15.7
Relative emphasis											
			2.28	.58	-.33	.25	.97	.33	.50	.53	
Expected genetic gain											
			1.82	.02	-.16	.07	.03	.03	-	-	
Ewes											
Advantage of selected lambs											
			2.27	.29	1.14	-.13	.01	.18	.26	.06	31.6
Relative emphasis											
			.29	.55	.55	-.23	.02	.33	.26	.08	
Expected genetic gain											
			.47	.02	.34	-.06	.00	.02	-	-	

* Heritability for face covering score as obtained for range Targhee and Columbia lambs at Dubois, Idaho.

SELECTION PRACTICED ON FINE WOOL, CROSSED WEANLING LAMBS, CONT.

Group No.	Sex		Meaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer- coat (score)	Per- cent saved
T 15	Rams	Advantage of selected lambs	.52	.16	-1.85	.14	.41	.05	.37	.70	15.7
		Relative emphasis	.07	.26	-1.00	.22	.62	.12	.67	.58	
		Expected genetic gain	.11	.01	~ .55	.06	.02	.10	-	-	
	Ewes	Advantage of selected lambs	4.02	.09	.22	.14	.44	.17	.03	.38	22.2
		Relative emphasis	.59	.21	.12	.15	.78	.30	.05	.56	
		Expected genetic gain	.84	.01	.06	.06	.02	.02	-	-	

BODY WEIGHTS AND SCORES OF FINE WOOL, CROSSBRED YEARLING RAMS

Only two fine wool yearling rams were saved from the 1951 lamb crop. The body weights and scores of these two rams, along with the summary of the two previous years, are given in the following table.

Breeding Group No.	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
12	2	101.0	1.94	3.05	3.44	1.00	2.00
Totals & Averages							
1952	2	101.0	1.94	3.05	3.44	1.00	2.00
1951	13	113.7	3.10	1.84	2.07	1.38	2.05
1950	24	113.3	2.99	2.43	2.13	1.13	1.35

FLEECE CHARACTERISTICS OF FINE WOOL, CROSSBRED YEARLING RAMS

The fleece characteristics of the two fine wool rams saved in 1952 are summarized in the following table. No kemp or other medullated fibers were evident in the fleeces of either ram.

Breeding Group No.	No. of rams	Fleece weights		Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12	2	7.71	3.86	58s	9.2
Totals & Averages					
1952	2	7.71	3.86	58s	9.2
1951	13	9.84	3.36	62s	9.5
1950	24	8.96	4.89	60s	11.5

BODY WEIGHTS AND SCORES OF FINE WOOL, CROSSBRED YEARLING EWES

The body weights and scores of the 21 yearling ewes in research project 3 are summarized in the following table. Only small differences are apparent between any of the three groups represented. Due to the small numbers of ewes involved and the effects of the drought in 1951 and 1952, no valid comparison can be made between years.

Breeding Group No.	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
12	11	88.0	2.11	2.45	2.25	1.94	1.41
13	1	78.0	1.66	2.22	2.11	5.00	1.33
T15	9	86.9	2.37	2.58	2.35	1.46	1.37
Totals & Averages							
1952	21	87.0	2.09	2.49	2.29	1.90	1.39
1951	35	55.4	3.03	2.47	2.49	1.20	2.01
1950	49	81.8	2.76	2.22	2.13	1.14	1.68

FLEECE CHARACTERISTICS OF FINE WOOL, CROSSBRED YEARLING EWES

Only small differences can be observed between groups in fleece characteristics of the yearling ewes in 1952. None of the fleeces of the yearling ewes possessed any kemp or other medullated fibers. Staple length appears to be slightly shorter than for the years of 1950 and 1951. The 1952 fleece weights, both grease and clean, are heavier than in 1951, but lighter than those of 1950.

Breeding Group No.	No. of ewes	Fleece weights		Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12	11	6.65	2.98	60s	6.4
13	1	6.39	2.76	58s	6.3
T15	9	6.37	2.80	60s	6.2
Totals & Averages					
1952	21	6.52	2.89	60s	6.3
1951	35	5.00	1.90	80s	9.2
1950	49	8.70	3.64	70s	9.1

